Space Weather Technical Forecast

Issued on Sunday, 27 August 2023 at 01:10 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of isolated M-flares (R1-R2 Blackouts). CME arrival possible day 4 (30 Aug) with slight chance of G1 Minor Storms.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate with one long period M1.1 flare observed peaking 26/2250 UTC from an uncertain source over the east limb. There are six sunspot regions on the disc. AR3413 persist as the largest region on the disc, with ongoing development of small peripheral spots, but no overall growth observed. This was also the source of a C2.2 flare peaking at 22/1006 UTC, with an associated coronal dimming and subsequent weak CME observed. AR3415 remains the most complex looking region, with a clear delta configuration, however this has remained inactive since its M1.4 flare on 25 Aug, with some signs of decreasing penumbral extent. AR3405, is unipolar region very close to the west limb that will soon rotate off the visible disc. The other two regions are small unipolar spots.

The CME from the C2.2 flare of AR3413 has been analysed as likely Earth-directed, but was very faint and narrow. Subsequent arrival is currently modelled for day 4 (30 Aug), however confidence is low with any potential impacts.

Solar Wind / Geomagnetic Activity: Observed solar winds by ACE at L1 were at background, largely between 350-400 km/s, with average to below average density. The interplanetary magnetic field (IMF) Bt, was predominately Weak, below 8nT, but briefly peaked at Moderate (just over 8nT) between 26/2050-2130 UTC. The north-south component has been mainly negative (southward) with only brief periods of positive (northward) direction, varying between +4/-7nT. Phi angle was predominantly positive (away from the Sun), but has shown recent signs of switching to negative (towards the Sun) since 26/2230 UTC, perhaps indicating the imminent onset of CH38/- fast winds. Geomagnetic activity was Quiet (Kp 1-2).

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux remained at Background. GOES16 high energy (greater than 2MeV) electron flux was mostly at Background, rising briefly to peak Moderate with 280 pfu at 26/1440 UTC. The associated 24-hour fluence was well below Active, with 5.52e6 integrated pfu observed at 27/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar Activity is expected to be generally Low, but with a chance of isolated M-class flares.

Solar Wind / Geomagnetic Activity: CME from C2.2 flare on 26 Aug is forecast to arrive on day 4 (30 Aug), however given the faint signal in coronagraph imagery, and expected background wind speeds, confidence is Low with any notable impact or increase to geomagnetic activity. The transition into the fast wind of CH38/- is expected imminently on day 1 (27 Aug), with solar winds rising to 450-500 km/s. These winds then easing back toward background day 2 (28 Aug) onward. Geomagnetic activity is forecast to become Unsettled with Active intervals day 1 (27 Aug), before easing back to be mainly Quiet with isolated Unsettled intervals day 2 onward. CME arrival on day 4 (30 Aug) is likely to increase activity again to Unsettled to Active, with a slight chance of G1 Minor Storm intervals.

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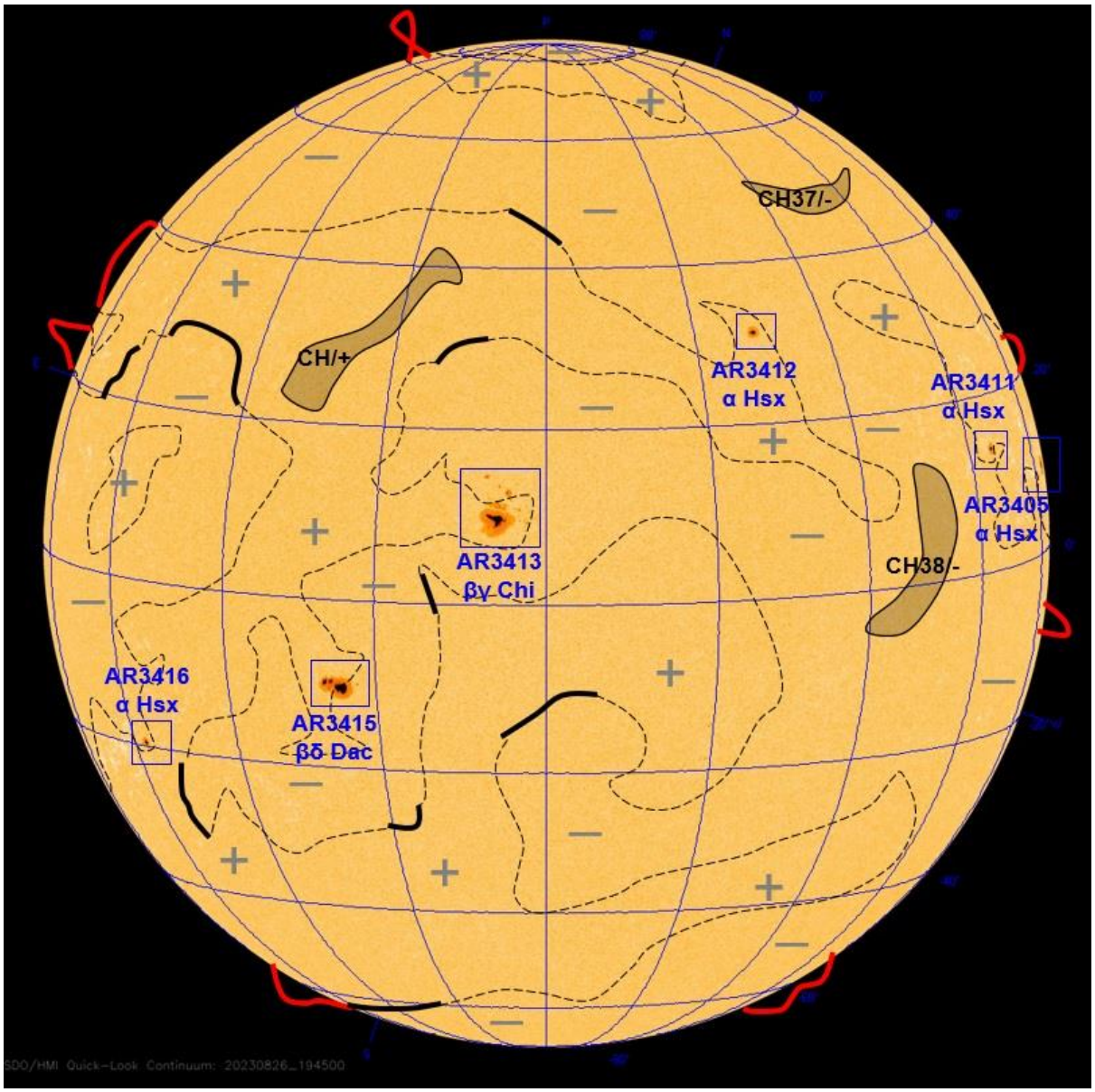
Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is expected to remain at Background. High energy (greater than 2 MeV) electron flux is expected to persist at mainly Background until any subsequent enhancement from CH37/38 eases later day 1 or more likely day 2 (27-28 Aug). Flux is then likely to rise, perhaps to Moderate, with a slight chance of rising to High (1000 pfu) at peak periods late day 3 or day 4 (29-30 Aug). The associated 24 hour fluence is expected to remain below the Active level (1e8 integrated pfu).

Figure 1. Solar Analysis Valid 26/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There is one weak CME expected to arrive at Earth on day 4 (30 Aug). This is from the C2.2 flare of AR3413 at 25/1006 UTC, with a very faint eruption subsequently detected in SOHO imagery. There are no other Earth-directed CMEs.

The fast wind of CH38/- is expected early on day 1 (27 Aug), with speeds 450-500km/s. Negative polarity coronal holes are unfavoured for a strong connection at this time of year, with geomagnetic activity expected to increase to Unsettled to Active, and only a slight chance of G1 Minor Storms. These winds then easing day 2 onward (28 Aug), as supported by MOSWOC Enlil. Mainly Quiet geomagnetic activity the expected, with isolated Unsettled intervals. Any CME arrival on day 4 will likely bring a spell of Unsettled to Active, with a slight chance of G1 Minor Storms.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	1	1	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
26/1733	Partial	C2.2 flare	NW-centre disc	529km/s	30/1200 UTC +/- 10 hours	Low confidence. Directed SE, despite NW location

Figure 2a: Dimming observed with flare, from sidc.be/solardemon, showing SE direction.

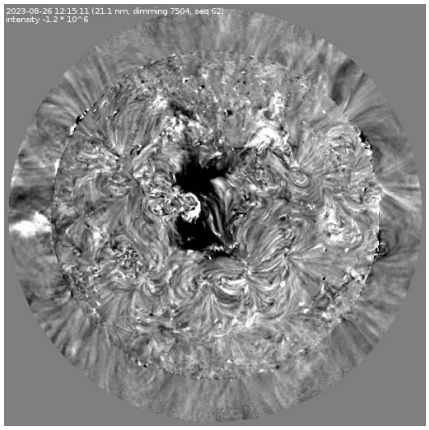

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Figure 2b: Enlil showing expected arrival, on 30 Aug

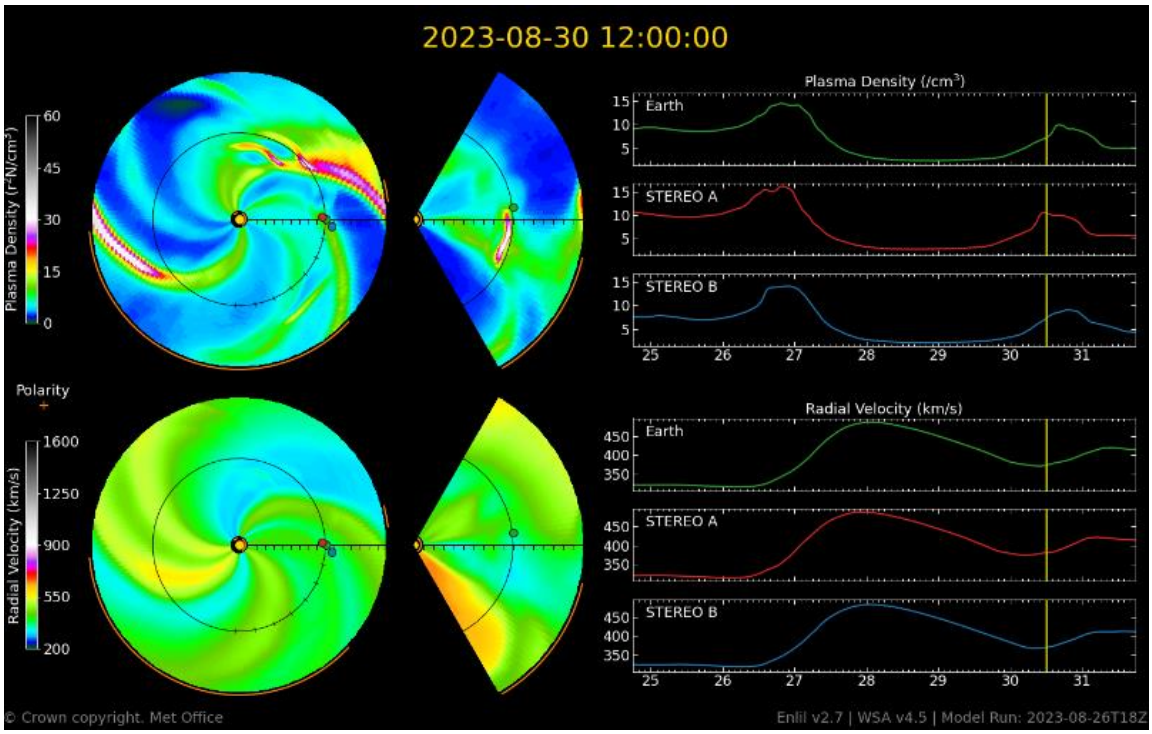
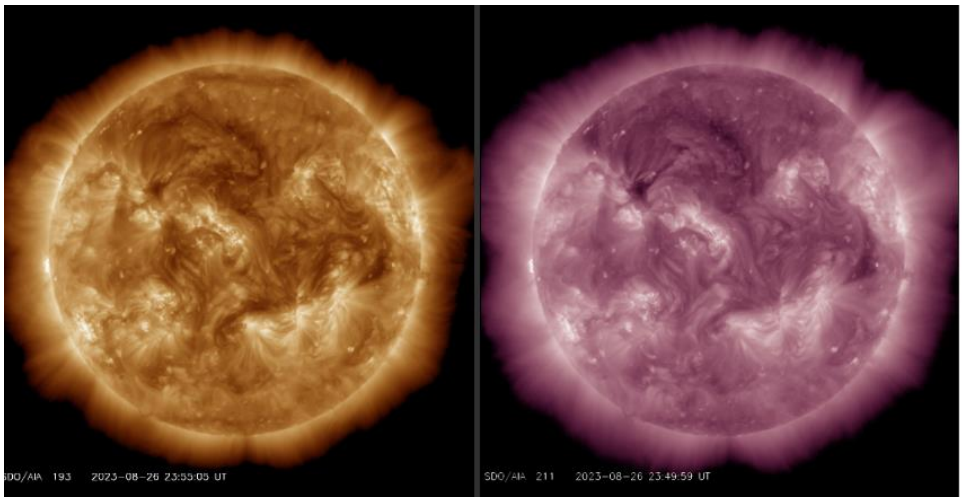


Figure 2c: SDO aia 193 and 211 showing potentially weak coronal holes in the west



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Radio Blackouts - X-Ray Flares:

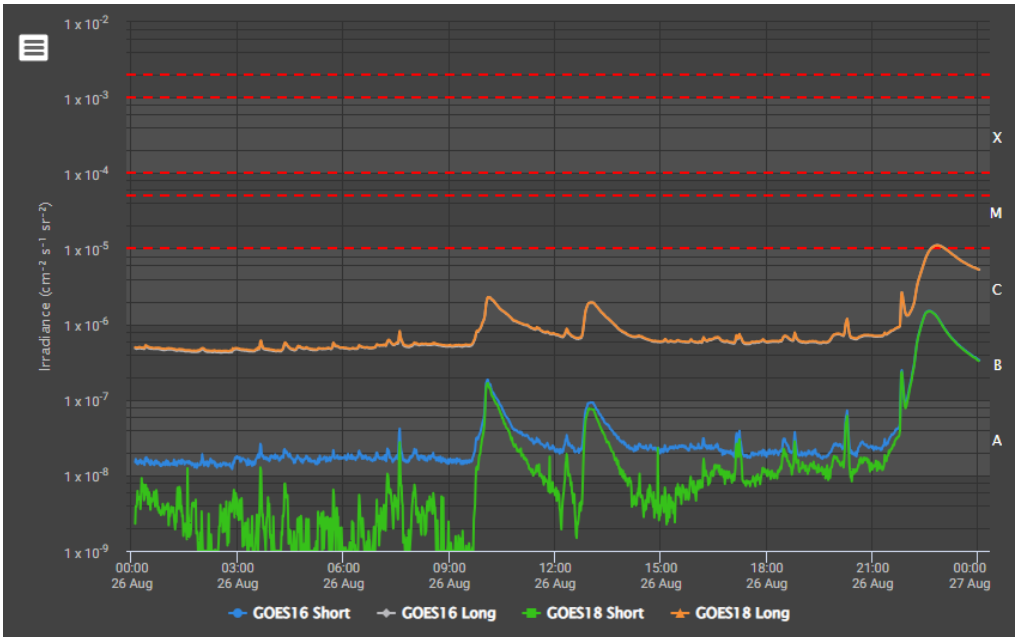
Low activity is forecast with a chance of rising to Moderate with isolated M-flares.

There are six sunspots on the disc. The largest region is AR3413 in the centre disc, however despite the emergence of small spots around the main dominate leader spot, this has remained inactive with only low c-flares observed from this region. AR3415 in the southeast has also remained stable despite its clear delta configuration. This is a small region, and has shown some indication of weakening, leading to a reducing flare risk. The other regions are all simple, mature and inactive unipolar spots, including previously more active AR3405 which is now rotating off the disc.

The source of the M-flare on 26 Aug was just over the east limb, and may increase activity once it rotates onto the eastern disc, however the timing of this is currently uncertain.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	30	30	30	30
Very Active	R3 to R5 X Class	No	2	2	2	2

Figure 3: GOES 16/18 X-ray flux. M1.1 flare from E limb.



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Solar Radiation Storms - (High Energy Protons):

High energy (greater than 10MeV) proton flux observed by GOES16 is expected to remain at Background. The main risk of any increased proton flux would be from the occurrence of any larger flares of AR3415 or AR3413.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	2	2	2	2
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy (greater than 2 MeV) electron flux observed by GOES16 persisted at mainly background levels, with only a subdued response to the recent high speed stream. A further fast wind arrival either day 1 (27 Aug) may bring a further enhancement. However, given the limited geomagnetic response anticipated, any increase to the observed flux expected to be rather limited, likely peaking at Moderate and only a slight chance of reaching High at diurnal maximum

The associated 24 hour fluence is expected to remain below the Active (1e8 integrated pfu) level, but rising later the period in response to this enhancement. Below Active fluence is currently supported by REFM.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	5	10	10
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

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